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Comparison of Methods for Evaluation of Chemical Lipid Content in the Longissimus Muscle

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Abstract
For the range of fat content found in pork, the two chemical procedures studied for the estimation of intramuscular fat (IMF), Soxhlet and total lipid (TL), are highly correlated and values for the Soxhlet procedure are slightly lower. No significant ($P<.05$) differences existed between the two methods. Hence, both methods can be recommended for the determination of IMF in pork. The Soxhlet method, however, may be more indicative of marbling than the TL procedure.

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Comparison of Methods for Evaluation of Chemical Lipid Content in the *Longissimus* Muscle

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Summary and Implications

For the range of fat content found in pork, the two chemical procedures studied for the estimation of intramuscular fat (IMF), Soxhlet and total lipid (TL), are highly correlated and values for the Soxhlet procedure are slightly lower. No significant ($P<.05$) differences existed between the two methods. Hence, both methods can be recommended for the determination of IMF in pork. The Soxhlet method, however, may be more indicative of marbling than the TL procedure.

Introduction

The quantity and chemical properties of lipids in pork are regarded as important factors affecting carcass quality (Cameron et. al., 1991). With the trend in modern pork production leading towards a leaner pork product, there is considerable concern of the possibility of a reduction of intramuscular fat in pork (Schwörer et. al., 1995). Various methods exist for the chemical determination of intramuscular fat in meat (Reichardt, 1995). These tests are used for the classical determination of the IMF content in meat and are also necessary for calibration of ultrasound, spectroscopic, or other methods of quantitative fat analysis. With the potential of incorporating IMF data into a selection index to prevent the decline of IMF in lean pork, the comparative value of chemical methods must be known and a standard established for the chemical determination of this trait.

The purpose of this study was to investigate the relationship of two of the more commonly used methods, Soxhlet and TL, for chemical determination of IMF and to determine their respective relationships to marbling.

Materials and Methods

Loin chops from the 10th rib of the *longissimus* muscle of 66 crossbred market hogs (26 gilts and 40 barrows), with average liveweight of 257 lb. were scored for marbling, as outlined in Procedures to Evaluate Market Hogs (NPPC, 1991, 3rd ed.). A sample was excised from each loin chop. The chemical analyses for IMF were performed in duplicate on the subsamples of ground meat of the excised samples.

The intramuscular lipids were measured by extraction in a Soxhlet apparatus with petroleum ether (AOAC, 1990) and with methanol and chloroform according to the TL method of Bligh and Dyer (1959).

A least squares analysis of variance procedure according to a general linear model (SAS, 1985) was used to evaluate dependent measurements for sources of variation. The model included the effects of sex and pig(sex) and the linear covariate of carcass weight. Pig(sex) was used as the error term to test sex differences. Pearson product-moment correlations were used to analyze relationships between chemical IMF determination methods and marbling on a total and residual basis (after accounting for effects in the model). Additionally, rank correlations were calculated. The regression of Soxhlet on TL was calculated, as well as the reverse regression.

Results and Discussion

Means, standard deviations, and ranges for traits are presented in Table 1. The chemical lipid values for the Soxhlet method were more variable and exhibited a larger overall range than the values for the TL method. Product-moment correlation coefficients among Soxhlet and TL estimates of percent lipid were 0.79 and 0.74 ($P<.01$) on a total and residual basis, respectively. The rank correlation between the two methods was 0.84. The product-moment correlation coefficients among the Soxhlet method and marbling score and the TL method and marbling score were 0.23 and 0.30, respectively. The TL method gave a higher value in 42 of the 66 pigs, and a higher overall mean value.

Least squares means and standard errors for percent IMF by method across sex are shown in Table 2. Significant sex effects were found for both methods with the Soxhlet estimate of IMF of barrows exceeding that of gilts by .06%. The estimate of barrows exceeded the estimate of gilts by .08% for the TL method.

Least squares means and standard errors for percent IMF are shown by method in Table 3. The difference was not significant between the two methods.

Linear regressions (PROC REG) predicting % IMF for both the Soxhlet and TL methods are given in Table 4.

Table 1. Means, standard deviations (SD) and ranges for traits.

Trait	Mean	SD	Range
Off weight, lb	257.3	7.64	250 - 290
Carc. weight, lb	187.9	8.09	155 - 215
Soxhlet % IMF	2.28	1.19	0.62 - 6.69
Tot. Lip. % IMF	2.38	0.99	0.98 - 6.15
Marbling Score	2.53	0.64	1 - 4

Table 2. Least squares means and standard errors for % IMF by sex.

	Variable	
	Soxhlet % IMF	TL % IMF
Sex		
Barrow	2.30±.05[a]	2.42±.05[a]
Gilt	2.24±.06[b]	2.34±.06[b]

Means with same superscripts do not differ.

Table 3. Least squares means and standard errors for % IMF by method.

Method	
Soxhlet % IMF	2.27±.06[a]
Tot. Lip. % IMF	2.38±.06[a]

Means with same superscripts do not differ.

Conclusions

The results of this study indicate there are no significant differences between the Soxhlet and TL methods for chemical determination of IMF. The correlation between the two methods is high, with slightly lower mean values for the Soxhlet procedure. Therefore, both methods are feasible to use for determination of IMF levels. The Soxhlet method, however, may be more reflective of marbling than the TL procedure, because the Soxhlet method detected a larger range than the TL method in this study. Additionally, the TL procedure dissolves all lipids in the lean tissue. This includes lipids which make up the bilayers of the cell wall, which are not contributive to IMF.

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Table 4. Regression equations predicting percentage IMF by Soxhlet and Total Lipid methods.

		ß-value		
Dependent Variable	Intercept	Soxhlet % IMF	Total Lipid % IMF	R^2
Soxhlet % IMF	-.0067	----	.9527*	.63
Total Lipid % IMF	.8768*	.6654*	----	.63

* P<.001